RESTRICTED CIRCULATION

THIS PAPER IS NOT AN OFFICIAL DOCUMENT: IT IS FOR INFORMATION ONLY AND MUST NOT BE QUOTED IN ANY PRINTED PUBLICATION.

SPRING FROST SURVEY AT THE BEWL BRIDGE RESERVOIR

Agricultural Memorandum No. 895

Introduction

Bewl Bridge Reservoir is part of the Southern Water Authority's River Medway Scheme by which areas of Mid and North Kent are supplied with water. At the same time this trident shaped 3.1 km^2 reservoir is the largest stretch of inland water in S.E. England and is a valuable addition to the leisure resources of the South East.

The reservoir was established by inundating some 300 ha (770 acres) of Chesson's and Overy's farms owned by Messers. Fuggle and Reeves; of particular interest to these growers was the possible influence of such a body of water on frost frequencies in the locality since their top and soft fruit (principally blackcurrents) occupy areas on the slopes down to the reservoir. (See Fig 1, 2).

This memorandum presents the results of a study over two spring seasons (1979 and 1980) of minimum temperature readings made at ten sites at *two locations adjacent to the reservoir: Chesson's farm to the south west, (height range: 76 to 129 m) and Overy's to the east (76 to 100 m)

Although Hogg (1971) has gathered notes on the possible effect of reservoirs on local climate these refer generally to vast inundations such as the Great Lakes or reservoirs of thousands of hectares area; detailed studies of the effect of small British lakes and reservoirs are very few.

---

*frost and humidity measuring equipment waiting to be put out on a third site at the Recreation Area to the north of the Reservoir and opposite Chesson's was destroyed by fire in March 1980.

FH23

There are statements such as 'minima in the reservoir - filled upper Derwent Valley may be 1 to 2° C higher than those at similar altitudes in adjacent unsubmerged valleys'; Gregory and Smith (1967) in their study of the Selset (Tees Valley) Reservoir conclude that 'the observed (climate) modifications are smaller and more variable than have sometimes been supposed..... For a high proportion of the time the advective influences amount to less than 0.5°C and, although a diurnal cycle is detectable, the maximum effect rarely exceed 2.5°C'. They go on to suggest that 'the rate at which these advective influences decay away from the water's edge are fields of study which have received too little attention.'

Harding (1979) describes a study at Cow Green (Upper Teesdale) for which data were gathered for several years before impoundment in 1970-71 (whereas most studies relate the existing site variables to those in a dry valley, or some other site, some distance away). Harding noted the mean lowest temperature minima were significantly different and an even greater effect was noted in the mean lowest grass minima; humidity and windspeed were unaffected. i.e. the Cow Green reservoir has a moderating influence under intense nocturnal cooling conditions but the small proportion of nights involved means that the mean is not significantly affected.

The present Bewl Bridge study does not have the advantage of "beforehand" data; the distribution of sites does, however, give temperature data at various heights and distances from the reservoir.

Methodology

The site Overy's 1 (O_1) was taken as 'reference' and a Stevenson screen was established close to a cocoa tin exposure; all other sites had a cocoa-tin 1 metre exposure height. Screen and cocoa tin minima were read daily by the growers over the 1 April - 31 May period in 1979 and 1980. The data were tabulated according to whether they referred to "radiation" nights or not; corrections were applied for the differences between cocoa tin

and standard exposures. Frost frequencies for the reference and other sites were deduced by reference to long term (1959 - 77) data available for Goudhurst (Fig. 3) some 4 km to the N.E. of the reservoir. Analysis of wind and radiation frosts for the area by Roe (1980) confirms that the low incidence of wind frost renders the Goudhurst frost frequency ogives applicable for estimating the radiation frost frequencies (below stated thresholds) at the Overy's and Chesson's sites.

Discussion of results

The data for the two spring seasons were consistent and averages are presented in tabular form for 'Radiation' (table 1) and 'Other' nights (table 2) at eight sites with heights as indicated (columns 'v' and 'w').

Columns 't' and 'y' show the Goudhurst (G) minimum temperature minus site minimum (O_n or C_n) after correcting for the difference between 'screen' and 'cocoa tin' exposures; see table sheet .

Columns 'u' and 'z' show the corresponding differences referred to the reference station O_1.

The figures in 't' and 'y' represent the correction to the ordinate to be applied so that fig 3 is applicable to the Overy's and Chesson's sites. Goudhurst is colder than O and C sites on radiation nights so that, for example, the frequency with which an air temperature of 0°C or below occurs at Goudhurst during a spring period is the same as that with which temperatures of -1.2, -0.7, -0.5, -0.5 and -0.8°C occur at O_1, O_2, O_3, O_4, and O_5 respectively. Apparently on other than radiation nights, when advective conditions dominate, most O and C sites are cooler than Goudhurst (Table 2), O_1 and C_1 being slightly warmer, so that the corresponding frost probability corrections are -0.1, +0.1, +0.6, +0.6 and +0.4 for sites O_1 to O_5 respectively.

Although then the relative warmth with respect to Goudhurst depends on whether the night is a "radiation" one or not, the relative internal differences between O_1 and the other sites are similar (Table 1, 'u' and 'z'), O_3, O_4 and C_3 showing the biggest differences. All sites are colder than O_1 except C_1 (100 m higher than O_1).

The meterological site designated Goudhurst is, in fact, in Bedgebury Forest (NGR TQ 722 333) only 4 km ENE of Overy's and 6 km ENE of Chesson's at a height of 85 m, similar to O_2, O_4 (Fig 1, 2) ENE of Overy's the land rises to 135 m at Flimwell Grange; Bedgebury is on the north-facing slope NE of Flimwell Grange, the valley then sloping down to 35 m to a tributory of the R. Teise.

It would not be unreasonable to regard Goudhurst as being the dry valley equivalent to Bewl Bridge sites O_2, O_3, and C_3. The (negative) sense of $G-O_n$ and $G-C_n$ in table 1 ('t' and 'y') might then be taken as indicating a warming influence of the reservoir on all sites on radiation nights, although lower sites still apparently demonstrate katabatic effects (since O_1-O_n and $O_1 - C_n$ are generally positive).

Although Goudhurst is warmer than Bewl Bridge on other nights the lower sites are still cooler than reference site O_1.

Please refer all comments and suggestions to the author.

JR Starr

Meteorological Office

MAFF, Reading

August 1980

References

Harding, R.J. (1979) "A note on the effect of the Cow Green reservoir on the local climate". J. Inst. of Water Eng. & Scientists Vol 33, No 3 p 752 - 754, May.

Hogg, W.H. (1971) "Notes on the possible effect of reservoirs on local climate". Agricultural Memorandum 390

Gregory, S. and Smith, K (1967) "Local temperature and humidity contrasts around small lakes and reservoirs" Weather, 22, p 497 - 505

Roe, C.P. (1980) "Frequency of wind and radiation spring frosts in S.E. England" Agricultural Memorandum 883

Sims, F.P. (1975) Frost surveys - a revised method of analysis Agricultural Memorandum 757

'Radiation' Nights

Table 1

Overy's	$G - O_n$ (°C)	$O_1 - O_n$ (°C)	Height		Chesson's	$G - C_n$ (°C)	$O_1 - C_n$ (°C)
			ft	m			
-	-	-	425	129	C_1	-1.6	-0.4
-	-	-	345	105	C_2	-0.8	+0.4
O_5	-0.8	+0.4	330	100	-	-	-
O_1	-1.2	0	320	97	-	-	-
O_2	-0.7	+0.5	280	85	-	-	-
O_4	-0.5	+0.7	275	83	-	-	-
O_3	-0.5	+0.7	250	76	C_3	-0.5	+0.7

'Other' Nights

Table 2

Overy's	$G - O_n$ (°C)	$O_1 - O_n$ (°C)	Height		Chesson's	$G - C_n$ (°C)	$O_1 - C_n$ (°C)
			ft	m			
-	-	-	425	129	C_1	-0.2	-0.1
-	-	-	345	105	C_2	+0.3	+0.4
O_5	0.4	+0.5	330	100	-	-	-
O_1	-0.1	0	320	97	-	-	-
O_2	0.1	+0.2	280	85	-	-	-
O_4	0.6	+0.7	275	83	-	-	-
O_3	0.6	+0.7	250	76	C_3	0.7	+0.8

s t u v w x y z Column

Note: 'Screen' - 'Cocoa Tin' = 0.7° C 'Radiation Nights
0.2° C 'Other' Nights

Reservoir at about + 8° C
during the spring period.

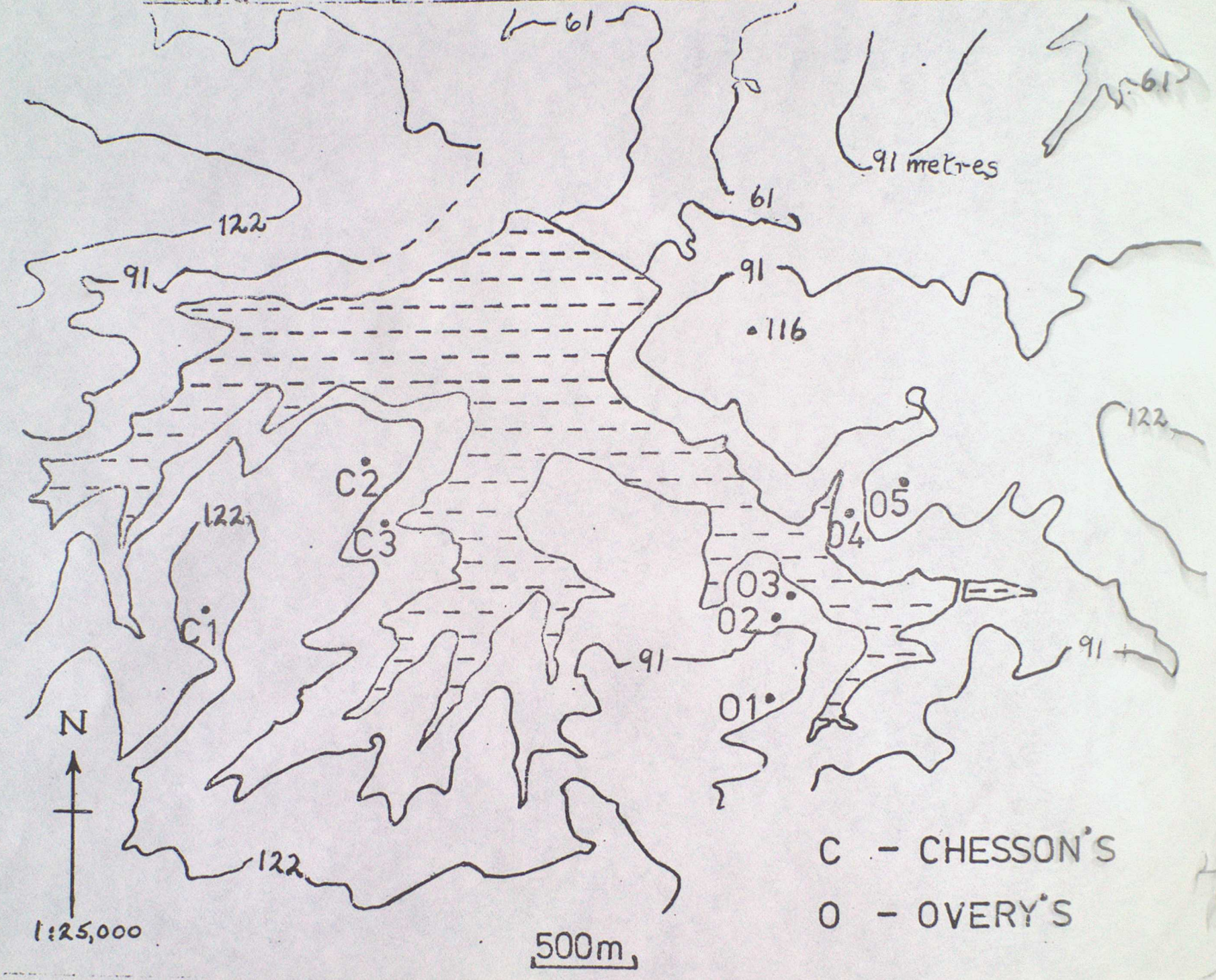
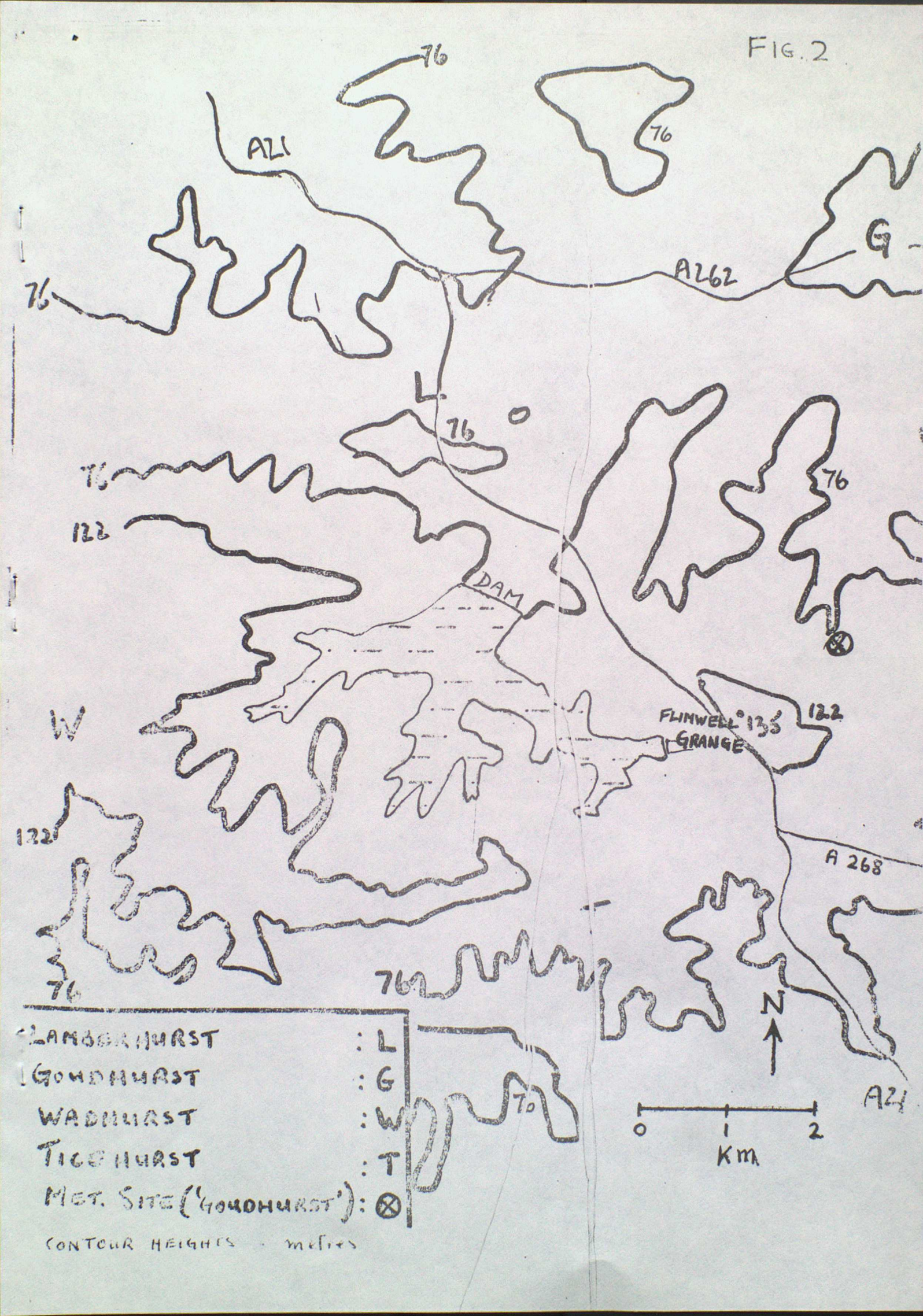

BEWL BRIDGE RESERVOIR [308 ha — 3·1 km²]
61
91 metres
122
91
116
C2
C3
C1
O5
O4
O3
O2
O1
N
1:25,000
500m
C - CHESSON'S
O - OVERY'S

FIG. 2



LAMBERHURST : L
GOUDHURST : G
WADHURST : W
TICEHURST : T
MET. SITE ('GOUDHURST') : ⊗

CONTOUR HEIGHTS - METRES

Fig 3

Goudhurst 1959-77

Probability of Air Frost during Spring